

The Vestibular Autorotational Test (VAT), Vestibular Rehabilitation (VRT) and Balance Retraining (BRT)

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The following discussion was prepared to document the medical necessity and efficacy of using the VAT and VRT/BRT as part of a comprehensive individualistic program to diagnose and treat patients suffering from chronic episodic and or continuous dizziness, vertigo, and/or dysequilibrium.

In particular, we will present detailed referenced material that describes under what circumstances with respect to patient diagnosis and circumstance is it appropriate to use these modalities and what advantages in patient outcome are seen as a result.

VAT

1. What is the purpose (need) of testing the VOR in patients with balance problems?

The VOR or vestibular ocular reflex utilizes two of the four components necessary to maintain normal balance. Balance requires inputs from the eyes, semi-circular canals/otolithic organs, proprioception sensors, and the sensory integration of these afferent signals. The VOR stabilizes our visual images by maintaining proper eye-head coordination during physiologically significant movement with a velocity sufficient to reflect real world every day activity. This mechanism occurs with head movement greater than or equal to two Hz. Below this velocity, saccades and smooth pursuit are employed to maintain image stability during normal locomotion. Improper or out of tolerance coordination can result in oscillopsia, and greatly contribute to dysequilibrium, dizziness and/or vertigo. Therefore it is imperative that we know the pathophysiological status of the VOR over a physiologically meaningful velocity range (up to 6 Hz and in 2 dimensions – yaw and pitch), including indications of whether the deficits are central or peripheral and if they are asymmetric (asymmetry is a measurement of CNS compensation).

Neil Shepard, PhD (Audiologist) and David Solomon, MD, PhD (Neurologist), from the Departments of Otolaryngology and Neurology, U. of Pennsylvania School of Medicine, summarizes in *Otolaryngological Clinics of North America*, v33: Number3, June 2000 page 457-9 the significance of evaluating the VOR as well as smooth pursuit and saccades in the balance disordered patient:

"Acceleration or deceleration movement of the head, producing stimulation of the one or more of the receptors on the one side with corresponding reduction of neural stimulation

(inhibition) on the other side, results in asymmetric neural input from the vestibular nerves. This asymmetrical input is interpreted by the central nervous system as either angular or linear movement. In addition, the asymmetry resulting from action of the semicircular canals causes a compensatory reflex eye movement in the plane of the canals being stimulated. This compensatory reflex movement of the eye is called the vestibulo-ocular reflex (VOR), and is opposite to the direction of acceleration. As the VOR is the primary system used for evaluating balance disorder patients from the horizontal canals, the authors concentrate on this response.”

“The principal function of the VOR is the control of eye position during transient head movements to maintain a stable visual image. In addition to this dynamic control system, several other neural pathways that are independent of head movement contribute to eye movement control. Control of smooth pursuit, saccadic and optokinetic eye movements assists in maintaining clear visual images and contribute to one’s perception of speed and direction of body motion. All of the oculomotor control systems (VOR and CNS gaze stabilizers) are used in harmony as one attempts to visualize targets of interest during daily activities.”

The VAT specifically measures VOR function, smooth pursuit and saccadic motion in response to head motion while maintaining visual fixation on a target. We call this the visual-vestibulo-ocular response (vVOR).

Hypo- or hyper- functioning labyrinths, for example, direct different therapeutic approaches for BPPV. In canalithiasis, the VOR is generally hypo-functioning (abnormally low gain) and in this case the Epley Maneuver (Epley, JM. The Canalith repositioning procedure: For treatment of benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg* 107:399, 1992) would be appropriate. However, if the VAT shows hyper-functioning (abnormally high gain) this suggests cupulolithiasis and the Semont procedure would be most appropriate (Semont, A. et al: Curing the BPPV with a Liberatory maneuver. *Adv Otorhinolarygol* 42:290, 1988). Of course in addition to VOR functional information a detailed history and recording nystagmus phenomena through patient wearing infrared video-oculography (AKA: VNG) while performing the Hallpike-Dix procedure is necessary to make an accurate diagnosis.

On page 100 of **Handbook of Vestibular Rehabilitation**, edited by Linda Luxon, MD and Rosalyn Davies, MD, consulting physicians in Neuro-otology at the National Hospital for Neurology and Neurosurgery, London, a summary of the comparative efficacy of various treatments of BPPV are listed. When hypo or hyper VOR function directs which of the two basic therapeutic modalities to use, the Epley or the Semont together with modified versions of their procedures by Herdman, an average cure rate of over 90% after 1 to 3 procedures results.

1a. Is there a different consideration if the problem is self-reported by the patient or if another medical professional requests balance testing for the patient?

The only significant difference between a self reporting patient and a referred patient is that

the referred patient (pt) tend to present with previously performed objective test results that may be helpful in determining the ultimate etiology of the their complaints. In addition we can determine the consistency of their history given at various times in the past.

The other difference relates to the fact that self-reporting pts tend to only report how they perceive their vertigo or dizziness while referred pts may bring evidence of gait or balance behavior observed by others and therefore the pt may not necessarily be aware of their actions in this context. Of course there is considerable overlap in the presentation of these two categories of subjective and objective presentations.

However, the self reporting pt's history is very extensive (see more details below) and our objective testing usually gives us sufficient data to base our therapeutic recommendations.

2. What additional value does VAT test results provide that ENG/caloric does not?

As demonstrated in numerous references previously submitted, the VAT provides information on VOR function through physiologically meaningful head velocities up through 6 HZ and measures the function of all 3 semi-circular canals. The ENG/caloric does not. It is limited to 0.001HZ (non-physiological) and only measures the horizontal canal.

In the Murphy reference previously submitted (American Journal of Otology/Volume 15, July 1994), only 22 out of 102 pts with balance and vestibular disorders had normal VAT results with abnormal ENGs. Therefore, the use of the VAT alone would result in determining the correct diagnosis is 80/102 pts or 78% of the time. However, most of the 22 pts in this "Normal VAT" group would have been diagnosed correctly by utilizing other criteria such as the use of a Hallpike-Dix test with Frenzel Lens Goggles for BPPV, MR/CT for acoustic neuroma in the face of continuing symptomatology without other abnormal test results, and Meniere's as a consequence of exclusion of all other diagnoses together with the nature of their history.

All in all, the remaining 11 pts with abnormal ENGs but normal VATs did not result in a diagnosis that suggested any specific treatment other than labyrinthectomy which would have been the treatment by default if a trial of VR was not effective in these cases.

2a. Is there a reason to use VAT only vs. using VAT and ENG?

If you obtain positive information with the VAT, then ENG would not add additional information. However, if the VAT was normal, and the pt continued to be symptomatic then an ENG may add information that would help direct therapy. Clearly from the Murphy study, the use of both tests would be more effective at arriving at a diagnosis for the 102 pts than either one alone. However, even though the conclusion of the study suggested that peripheral vestibulopathy was better detected with the ENG and central involvement was better determined by the VAT, there was considerable overlap in the ultimate diagnostic categories determined by the two tests (approximately 80%).

2b. With respect to medical necessity, reimbursement, and its appropriate use with specific diagnoses, how does the VAT compare to the ENG in the eyes of the FDA who has approved its sale for clinical use?

On April 6, 1987 a 510k Notification was sent to the FDA by the manufacturer of the VAT, Western Systems Research, requesting clearance to market its Vestibular Autorotational Test device under 21 CFR 807.87.

See Appendix #2. FDA 510k application letter to market the Vestibular Autorotation Test (VAT).

In that request was the following assertion comparing the ENG and the VAT:

- Substantial Equivalence: This product is similar in composition, function and intended use to the standard electronystagmography recording devices marketed prior to May 28, 1976, and to the Rotating Chair.” On July 27, 1987, The FDA reviewed and agreed with this assertion. See Appendix #3. FDA 510k approval letter to market the Vestibular Autorotation Test. Re: K871466A states:

- We have reviewed your Section 510(k) notification of intent to market the device referenced above and we have determined the device is substantially equivalent to devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments. You may, therefore, market the device, subject to the general control provisions of the Federal Food, Drug, and Cosmetics Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, and labeling, and prohibitions against misbranding and adulteration.”

We believe, in light of the above FDA opinion that the VAT must be thought of as an ENG with additional benefits of improved data collection capabilities as it relates to physiological VOR/head velocity measurements and the coverage of 3 canals not 1 as obtained by the standard ENG. In any case, where an ENG is medically necessary so is the VAT. Patient diagnostics that justifies ENG justifies VAT.

3. Is there a specific set of problem indicators that result in your determination to use VAT instead of, or in addition to, ENG?

Yes. After our extensive history and physical (see below for more details), which include Berg and Tenetti clinical evaluations, we look for a patient with chronic complaints of non-descript or specific dizziness, vertigo, positional vertigo, dysequilibrium following head movement, and/or dizziness following visual stimulation with moving fields. If after testing VOR function with a VAT, if results are normal, and symptoms continue without response to VRT, then ENG should be added to cover those individuals, about 20% that have normal VATs but abnormal ENGs.

4. Do you use VAT to analyze nondescript dizziness problems? What does it provide that other methods don't?

Yes. Nondescript dizziness as defined by the Murphy article includes those patients whose dizziness is not easily classifiable as to its exact patho-physiological basis. We use the VAT because in this context, it does give us an indication as to whether the problem is central vs. peripheral and whether there is asymmetry. This ability was not appreciated by Murphy, yet even in his study it correctly diagnosed peripheral and central based patients nearly 80% of the time relative to the ENG. In our experience and as published in several other studies, the VAT can distinguish between peripheral, central and asymmetric originating pathologies. Its ability to do this is dependant, however on the degree of vestibular dysfunction at the time of the testing. (Saasat, D et al 1995)

Again, in terms of VAT versus other tests, its head velocity range of up to 6HZ plus its measurement of all three axis instead of one makes it generally superior.

5. Do VAT test results establish a specific diagnosis?

The VAT test can determine the category in which a specific diagnosis can be assigned for a given pt and helps establish it along with other data collected during the initial diagnostic visits. It provides for the determination of hypo labyrinth or hyper labyrinth function, peripheral versus central deficits, asymmetry, smooth pursuit deficits, and presence or absence of saccades. It determines patterns of horizontal gain and phase changes corresponding to horizontal semi-circular canal function as well as vertical gain and phase changes corresponding to the anterior and posterior semi-circular canals as it relates to VOR function.

5a. If so, what set of results relates to what specific diagnosis?

Combining the results of the detailed neuro-otological history, physical exam and close examination of the VAT's graphic details as described in 5. above the following appropriate diagnoses can be deduced with varying degrees of confidence on a case by case basis:

- 334.2 Primary Cerebellar Degeneration
- 386.00 Meniere's disease, unspecified
- 386.04 Inactive Meniere's disease
- 386.10 Peripheral vertigo, unspecified
- 386.11 Benign paroxysmal positional vertigo
- 386.12 Vestibular neuronitis
- 386.19 Other vertigo otolith syndrome
- 386.2 Vertigo of central origin
- 386.3 Labyrinthitis, unspecified
- 386.34 Toxic labyrinthitis
- 386.35 Viral labyrinthitis
- 386.50 Labyrinthine dysfunction, unspecified

386.51 Hyperactive labyrinth, unilateral
386.52 Hyperactive labyrinth, bilateral
386.53 Hypoactive labyrinth, unilateral
386.54 Hypoactive labyrinth, bilateral
386.9 Unspecified vertiginous syndromes and labyrinth disorders
780.4 Dizziness and light-headedness, dysequilibrium

6. Do you have a detailed H&P that is typically expected before you determine the need for VAT tests?

Yes. Please see History & Physical Forms listed under description #1. History and Physical forms and provided in Appendix.

As described in Baloh RW, Honrubia V: Clinical Neurophysiology of the Vestibular System, 2nd ed. Philadelphia, FA Davis, 1990, and as presented in Goldman: Cecil Textbook of Medicine, 21st Ed., Copyright © 2000 W. B. Saunders Company:

“The history is key because it determines the type of dizziness (vertigo, light-headed, feeling of dissociation, disequilibrium), associated symptoms (neurologic, audiologic, cardiac, psychiatric), precipitating factors (position change, trauma, stress, drug ingestion), and predisposing illness (systemic viral infection, cardiac disease, cerebrovascular disease) (Table 517-1) . The examination should include complete neurologic, head and neck, and cardiac assessments. When focal neurologic signs are found, neuroimaging usually leads to specific diagnosis. When vertigo is present without focal neurologic symptoms or signs, audiometry and electronystagmography aid in localizing the lesion to the labyrinth or eighth nerve.”

TABLE 517-1 -- DISTINGUISHING BETWEEN VESTIBULAR AND NONVESTIBULAR TYPES OF DIZZINESS

VESTIBULAR

Common descriptive terms spinning (environment moves), merry-go-round, drunkenness, tilting, motion sickness, off-balance Light-headed, floating, dissociated from body, swimming, giddy, spinning inside (environment stationary)

Course Episodic Constant

Common precipitating factors Head movements, position change Stress, hyperventilation, cardiac arrhythmia, situations

Common associated symptoms Nausea, vomiting, unsteadiness, tinnitus, hearing loss, impaired vision, oscillopsia Perspiration, pallor, paresthesias, palpitations, syncope, difficulty concentrating, tension headache.

From Baloh RW, Honrubia V: Clinical Neurophysiology of the Vestibular System, 2nd ed. Philadelphia, FA Davis, 1990.

In addition to the comprehensive history that is taken, we perform a drug-drug interaction analysis utilizing a computer program written by the publishers of the PDR on every patient who is currently taking or has taken 2 or more medications. This allows us to determine the degree to which their medications could be contributing to their balance related symptomatology.

6a. What does VAT add to this detailed H&P?

Quantitative VOR functional data together with saccadic and smooth pursuit information that is impossible to accurately ascertain through the History and Physical alone.

7. How can VAT be used to monitor the effects of VRT?

The VAT gives us a baseline for divergence from normative data. The VAT simulates natural stimuli (The caloric and the rotation tests do not) because the VOR naturally acts to stabilize the fovea during walking and running at fundamental frequencies between 2-4 Hz with harmonics extending considerably higher (Grossman et al., Frequency and velocity of rotational head movements during locomotion. *Exp Brain Res*: 70, 470-476,1988).

The caloric and rotational tests do not go to velocities much greater than 2 Hz. Moreover the caloric and the rotational tests assess only lateral canal function and would not be expected to show any abnormalities in the vertical canal. Vestibular Rehab is specifically directed at stimulating the vVOR and therefore post effective rehab you will see a convergence of the patient's data on the VAT towards the normative data. (O'leary, Davis and Suann , Predictive Monitoring of High Frequency Vestibulo-ocular Reflex Rehabilitation Following Gentamamicin Ototoxicity. *Acta Otolaryngol (Stockh)*.1995; Suppl 520:202-204) summarized from Luxon and Davies Handbook for Vestibular Rehabilitation.

7a. Is this better than the patient's subjective scoring of the results of VRT? How?

Defining outcome measures is complex. While the patient's own perception is given significant consideration it cannot be the only basis for improvement as it does not take into account avoidance and maladaptive behavior which is particularly high in patients with vestibular dysfunction.

For example, for many patients symptoms of vertigo and dizziness is worsened by head movements. Some patients consciously or unconsciously avoid these movements and therefore may report an improvement in quality of life purely as a result of avoidance rather than due to recovery. Equally, patients with imbalance may avoid venturing outdoors or sit in a chair for much of the day thus avoiding falls, and the outcome measure of the number of falls will give a misleading view of progress due to rehabilitation. (Luxon,Davies Handbook of Rehabilitation)

VRT/BRT

1. What is the added value of VRT vs. other physical exercises?

Vestibular rehab is a specific approach to physical therapy aimed at reducing dizziness and imbalance by facilitating central nervous system compensation for peripheral and/or central vestibular dysfunction. There are many studies that support the effectiveness of VRT vs. other physical exercises which were included in the peer reviewed literature already sent to you. However, most specifically the research published in *Otolaryngol Head Neck Surg* 1992 Feb;106(2):175-80 (Horak et al) showed that when comparing 3 treatment approaches to dizziness: (Vestibular Rehab, general conditioning, and vestibular suppressant medication) in patients with vestibular symptoms only vestibular rehabilitation was effective in reducing both dizziness and improving their balance.

American Academy of Otolaryngology- Head and Neck Surgery (AAO-HNS)

The only AMA recognized board certifying organization in the United States has provided a clear policy statement with respect to the medical appropriateness and standard of care as it relates to VRT/BRT and Vestibular Testing. See #5 AAO-HNS Policies in the Appendix, below:

1460 Vestibular Rehabilitation Retraining Therapy

“Vestibular rehabilitation, or balance retraining therapy (BR), is a scientifically based and clinically valid therapeutic modality for the treatment of persistent dizziness and postural instability due to compensation after peripheral vestibular or central nervous system injury. Balance retraining therapy also is of significant benefit for fall prevention in the elderly patient suffering from multiple sensory and motor impairments.

Adopted 6/28/97, reaffirmed 3/1/98.

1160 Dynamic Posturography and Vestibular Testing:

The American Academy of Otolaryngology

1. Harmonic acceleration testing (rotary chair);
2. Vestibular rehabilitation therapy and
3. Dynamic platform posturography under the circumstances detailed in the Technology Assessment prepared by the Academy Task Force on Posturography.

Adopted 7/20/ 90, reaffirmed 4/3/95, revised 9/12/98.

Vestibular Testing Center, Dept. of Otolaryngology- Univ. of Michigan

"A balance therapy program is individually tailored for each patient by a physical therapist who has had special training in this (Vestibular Disorders) field. The therapist identifies what types of movements and activities can bring on symptoms, and whether or not the patient has difficulties walking or maintaining balance. The patient is given an exercise program

specifically designed to work on those movements which bring on symptoms, and if needed, to improve balance."

Dept. of Otolaryngology - University of Michigan - Programmatic Vestibular Rehabilitation; Neil T. Shepard, Ph.D; Steven A. Telian, M.D.

Results of the randomized clinical trial comparing the efficacy of customized and generic treatment protocols for patients with chronic vestibular dysfunction:

"Subjectively, 64% of the generic group and 85% of the customized group subjects reported complete resolution of symptoms or dramatic improvement. Although pretreatment disability levels were equivalent, only 50% of the subjects had no disability or minimal disability after generic exercises while 75% achieved these levels after a customized program ($p=.001$). The customized therapy group showed statistically significant resolution of spontaneous nystagmus and rotational chair asymmetries ($p=.004$) by the end of therapy, as well as significant reduction in motion sensitivity. They also had improved performance on clinical measures of static ($p=.01$) and dynamic balance ability ($p=.02$).

The only statistically significant change in the performance measures for the generic program was in static balance ability, probably reflecting the fact that one of the generic exercises was identical to one of the performance measures in this category. Only the customized group experienced a significant reduction in their dizziness during routine daily activities ($p=.01$)."

**The Bobby R. Alford Department of Otorhinolaryngology - Univ. of Texas
Greg Ator M.D.**

"Several large series have been published recently detailing results from vestibular rehabilitation programs. Horak and Shumway reported a prospective study of twenty-five subjects with a peripheral vestibular disorder and symptoms greater than six months duration. These patients were divided into three treatment groups. The first group underwent a tailored program of twice weekly outpatient exercises. The second group was given a regiment of general (Cawthorne) exercises. Finally, a third group was given medication such as Antivert® and Valium® only. The results are encouraging in that the patients who were given medications alone showed no objective improvement on posturography scores, but in the patients who had a tailored vestibular exercise regiment, there was a statistically significant increase in the posturography scores indicating improvement in compensation. A subjective dizziness index also showed significant improvement with the vestibular exercise program while no improvement was seen with the general exercise program and approximately 50% improvement with the medication only, group."

Vestibular Rehabilitation Program, Mayo Medical Center

"Vertigo, dizziness, spinning, wooziness, imbalance, BPPV, off-balance, falls, etc. are all symptoms or terms that may be associated with a vestibular (inner ear) disorder. Vestibular Rehabilitation may offer relief of symptoms for persons suffering from an inner ear disorder. Vestibular Rehabilitation is an exercise program designed by specially trained therapists to

help a person compensate for a loss or imbalance within the vestibular system."

"Because each patient's symptoms and needs are different, it is very important that the program be individually designed to meet those needs."

Dept. of Otolaryngology- University of Pittsburgh Medical Center

Functional Outcome of Vestibular Rehabilitation in Patients with Abnormal Sensory-Organization Testing. S.P. Cass M.D. Et Al.

" The results of this study suggest that a customized physical therapy program is beneficial for improving balance function, dizziness symptoms, and level of disability in patients with a variety of vestibular diagnosis."

1a. Why is a licensed Physical Therapist required?

1. Because of the constant assessment and reassessment of the patient during the treatment. Most patients present with multi-factorial complaints and care must be given to not flare up any other physical conditions involving neck, spine or orthopedic limitations from TKR to THR. As well as monitoring the other variety of systemic complications with heart rate and BP. As stated earlier most of our patients are multi-factorial and have multiple systems involved in some sort of decline.

2. Assessment regarding the degree of stimulation of the VOR is also key to successful rehabilitation. If one pushes the patient too far into over-stimulation then adaptation does not occur, conversely if one does not perform the exercises correctly (i.e. moves head but does not engage focusing as part of the exercise; or does not perform them at adequate speed and duration) adoption does not occur.

3. We have had many patients who have been handed exercises by an MD provider in hopes of reducing their dizziness symptoms to no avail. The patient comes to our clinic with skepticism because "I've already done head and eye exercises" but then quickly come to realize that despite the best instructions they were not performing them adequately and did not have an understanding of how to progress them or monitor their effectiveness.

4. Treatment for BPPV requires otolith repositioning and obvious skilled treatment with assessment of the integrity of vertebral artery sufficiency as well as cervical ROM.

5. Frequently symptoms of dizziness may be coming from decreased oxygen saturation or at other times it could be due to postural hypotension all in addition to a vestibular pathology. A skilled clinician must be able to determine the differences and have the tools to do so.

6. Frequently the vestibular involved patient is also a head injured patient and dealing with the cognitive and physical limitations of such an individual to allow for a successful outcome requires a skilled PT.

AAO-HNS Policy Statement: Vestibular Rehabilitation (Balance Retraining Therapy)

Author Joel A. Goebel, AID, FACS Equilibrium Subcommittee, American Academy of Otolaryngology

“BRT should be performed by a physical or occupational therapist specifically trained via postgraduate continuing education in this innovative , approach at the direction of the balance specialist. Performance of BRT by lesser trained individuals could lead to suboptimal and prolongation of therapy. Finally centers performing BRT must set realistic goals and reasonable time limits for BRT to avoid patient frustration and fiscal responsibility to third party payers.

2. If you cite a benefit of VRT, what is the duration of this benefit to the patient?

In our follow up of the majority of the patients seen by our practice and whose primary VRT was completed over 6 –12 months previously, the achieved improvements have thus far been maintained. In some instances the patients have reported a slight return of symptoms but resumption of the specific exercises has resulted in a reduction of their symptoms again. We are in the process of compiling these outcomes for future publication.

Susan L. Whitney and Maureen M. Rossi from the Departments of Physical Therapy and Otolaryngology, U. of Pennsylvania School of Medicine, summarizes in their chapter “Efficacy of Vestibular Rehabilitation”, Otolaryngological Clinics of North America, v33: Number3, June 2000 page 660, Table 1 a listing of 14 published references in which “Positive Outcomes for People with Peripheral Vesibular Dysfunction” had been documented:

References Patient Type Outcome Measure

Yardley, Beech, Zander et al 1998; Br J. of Gen Pract 48:1136-1140 Mixed Dx Subjective report, presence of nystagmus, and postural control.

Strupp, Arbusow, Maag, et al 1998; Neurology 51:838-844 Vestibular Neuritis Ocular torsion, subjective visual vertical, sway path

Szturm, Ireland, Lessing-Turner, 1994; J Vesibular Res 4:461-479 Chronic peripheral vestibular dysfunction VOR gain, standing balance

Aasi, Yukio, Shimizu, 1997; Acta Otolaryngol (Stockh) 582:116-120 Bilateral and unilateral peripheral vestibular function Postural control

Cass, Borello-France, Furman, 1996; Am J Otolaryngol 17:581-594 Mixed Diagnosis Postural control, subjective report

Fujino, Tokumasu, Okamoto, 1996; Acta Otolaryngol (Stockh) 524:21-26 Unilateral peripheral vestibular dysfunction Subjective reports, dynamic balance

Herdman, Clendaniel, Matto, 1995; Otolaryngology Head Neck Surg 13:77-86 Post-acoustic neuroma resection Postural control, subjective reports

Mruzek, Barin, Nicohls, et al 1995; Laryngoscope 105:686-692 Post-acoustic neuroma resection and Meniere's disease Dizziness Handicap Inventory (DHI), motion sensitivity quotient

Shepard, Smith-Wheelock, Telian, 1993; Ann Otol Rhinol Laryngol 102:198-205 Mixed Diagnosis Perceived disability, subjective symptom reports

Krebs, Gill-body, Riley, et al 1993; Otolaryngology Head Neck Surg 109:735-741 Bilateral vestibular dysfunction Gait velocity and quality, DHI

Cohen, Rubin, Gombash, 1992; Arch of Phys Med Rehabil 73:703-708 Mixed Diagnosis Activities of Daily Living (ADL) performance

Horak, Jones-Rycewic, Black, et al, 1992; Otolaryngology Head Neck Surg 106:175-180- Peripheral unilateral vestibular disease Postural control

Smith-Wheelock, Shepard, Telian 1991; Seminars in Hearing 12:297-303 Mixed Diagnosis Subjective symptom report, perceived disability score

Shepard, Telian Smith-Wheelock 1990; Neurol Clin 8:459-475 Mixed Diagnosis Subjective symptom report, perceived disability score

The expected benefit of VRT/BRT and its duration is directly correlated to the specific diagnosis:

Department of Otolaryngology- University of Michigan

Programmatic Vestibular Rehabilitation Neil T. Shepard, Ph.D
Steven A. Telian, M.D.

"The utility and success of VRT appears, to be population specific. In this section the results obtained to date on various populations of balance disorder patients will be reviewed.

Uncompensated/Decompensated Unilateral Peripheral Lesion Generally, this group has the best overall prognosis ... The percentage of patients that dramatically or completely improve increases from 30% among those having head injury, to better than 90% for those without head injury.

Benign Paroxysmal Positional Vertigo Patients with pure classical BPPV, comprised 9% of our series of 152 patients. When the patients were treated with a customized VRT program 100% had complete resolution of their symptoms.

Bilateral Peripheral Vestibular System Paresis. An uncontrolled prospective observational and a double blind controlled study both suggest improved performance and reduced symptoms with customized therapy programs for bilateral vestibular paresis patients.

Appendix

1. History and Physical forms used to determine balance specific information, entitled Comprehensive Balance Patient Historical Information and Initial Visit Balance Hx & PE.
2. FDA 510k application letter to market the Vestibular Autorotation Test (VAT) in interstate commerce, as substantially equivalent to the ENG as a clinical diagnostic tool under the Medical Device Amendments.
3. FDA 510k approval letter to market the Vestibular Autorotation Test (VAT) in interstate commerce, as substantially equivalent to the ENG as a clinical diagnostic tool under the Medical Device Amendments.
4. American Academy of Otolaryngology- Head and Neck Surgery (AAO_HNS) Policies, as printed in the AAO-HNS Bulletin, October 1998.